SYNTHESIS AND STRUCTURE OF SILVER-FILLED HYDROGEL NANOCOMPOSITES OBTAINED BY POLYMERIZATION WITH METAL DEPOSITION

A.V. Pokhmurska, postgraduate student, O.M. Grytsenko, D. Sc., Associate Professor, B.V. Berezhnyy, student

Lviv Polytechnic National University
79013 Lviv, S. Bandery str., 12
a.gaiduk92@gmail.com

In this work, the features of obtaining silver-filled nanocomposites based on copolymers of 2-hydroxyethylmethacrylate (HEMA) with polyvinylpyrrolidone (PVP) (Ag(0)/pHEMA-gr-PVP) and their hydrogels are investigated. The authors of the article for the first time proposed a method of metal-filled composite polymer hydrogels obtaining through the combining the processes of polymer matrix synthesis and the reduction of Ag^+ ions. Considering the medical application of Ag(0)-filled hydrogels the silver precipitation have been carried out from argentum nitrate in the aqueous-ethanol solution. It is determined by the thermometric research that the temperature conditions needed for chemical reduction of silver ions are achieved due to the heat, which releases during exothermic reaction of polymerization of compositions based on HEMA and PVP. The use of combined initiating system of iron (II) sulfate/benzoyl peroxide makes it possible to carry out the process of composites obtaining at room temperature, in the open air in 10-40 minutes with maximum exothermy temperature 70-121ºC.

The method is especially interesting as from the practical so from and the scientific point of view, because the particles of metal are formed simultaneously with the formation of polymer matrix. This approach makes it possible to achieve the better, uniform distribution of the filler and to obtain the material with the isotropic properties. It is confirmed due to infra-red spectroscopy with Fourier transformation, thermogravimetric and differential thermal analysis the formation of grafted net copolymer based on HEMA and PVP. It is determined through scanning electronic microscopy that materials obtained are characterized by the homogeneity of the structure and are filled with Ag(0) nanoparticles with size within 100 nm. X-ray analysis of the composites obtained confirmed the existence of metallic silver particles.

The antibacterial and antifungal properties of the obtained Ag(0)/pHEMA-gr-PVP composites were proved on the example of the test cultures of bacteria Escherichia coli, Staphylococcus aureus, Staphylococcus epidermidis, Streptococcus viridans and diploid fungus Candida albicans. The unique characteristics of the materials obtained - sorption capacity, strength, elasticity and form stability in the aquaeous medium, compatibility with different biological systems, provide the prospect of their use in medicine as medical products for various purposes.

The publication contains the results of studies conducted by President's of Ukraine grant for competitive projects Ф84/56870.